COMPUTER NOTES

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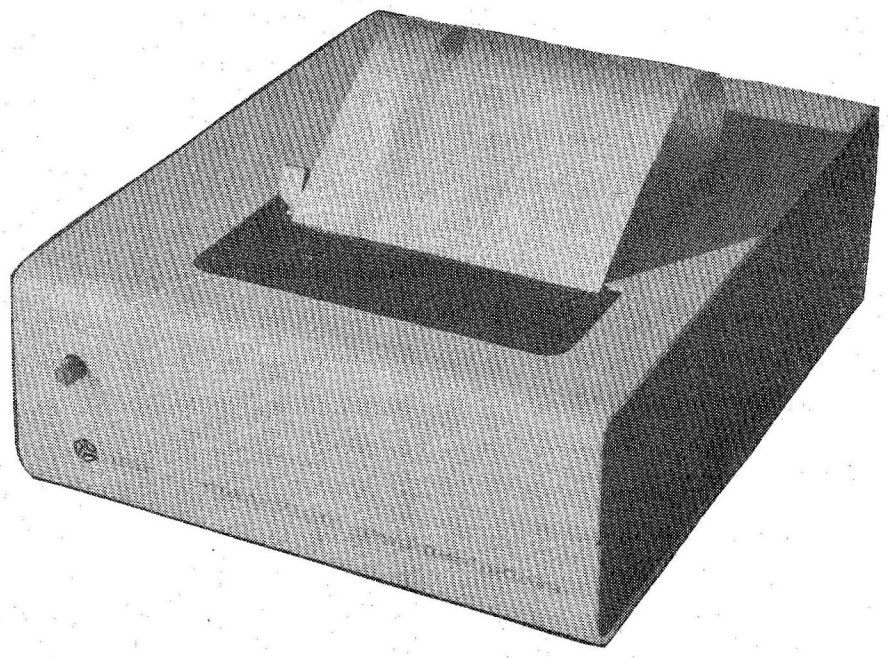
SEPTEMBER Vol. 2 Issue 4



Altair 7000 Graphics Printer

The tremendous flexibility of the 7000 Graphics/Printer, which acts as a printer, plotter and graphics device, makes it one of the fastest and most economical methods of electrostatic printing. The new Universal I/O board for the Altair 680b expands the I/O capabilities of the 680b beyond the one serial port on the main board. Thanks to the 88-Mux (24 Channel Multiplexer), the input capacity of the 88-Analog-to-Digital Converter for applications requiring a large number of analogs has been greatly increased. The new 88-S4K Memory Board now makes totally synchronous memory logic available to Altair 8800 users.

The 7000 Graphics/Printer

Although there are a number of methods used for printing computer output, electrostatic printing is finally being recognized as the only method which is fast, economical and, now with the MITS 7000, is also the most flexible means. In last month's C.N. we introduced the 7000 Graphics/Printer as a multifunction, hard-copy output device which is plug compatible with the 680 and 8800 mainframes via one PIO port. The enthusiastic response to the 7000 warrants a more detailed explanation of its operation and applications.

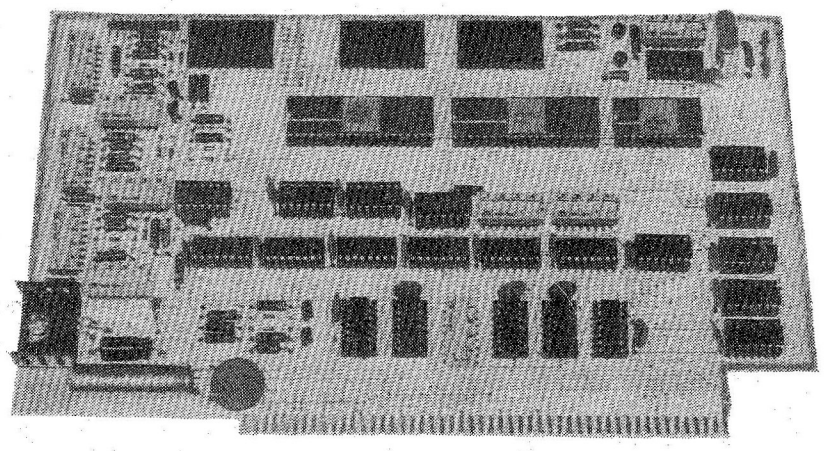
The flexibility of the 7000 is due to eight print electrodes, driven directly by software, instead of the usual seven found in 5 x 7 matrix printers. Copies made from the printed output are actually more legible than copies of typed paper and can be made for about 1¢ per foot of electrosensitive paper.

When the 7000 is used as a line printer, characters are generated using a 5 x 7 dot matrix. Altair BASIC supports three different sizes of character sets (each with upper and lower case) to produce line widths of 20, 40 or 80 characters in the four-inch wide printing area. The speed is 160 characters per second (80 characters per line) or 120 lines per minute. Different character sizes are selected with the CHR$ function in BASIC.

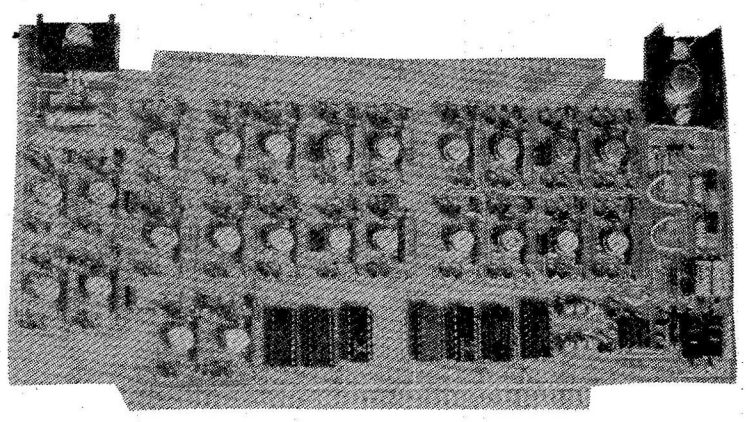
The eighth or extra printing electrode in this unit provides symmetry along the horizontal and vertical axes to permit plotting. With the vertical distance between electrodes equal to the distance between lines, there's no gap from line to line. This special feature makes the 7000 ideal for graphics. Pictures can be produced that show either a distinct outline or a sophisticated, detailed picture with shaded areas. When the eight-dot columns are printed close together,

– Continued on Page Four –

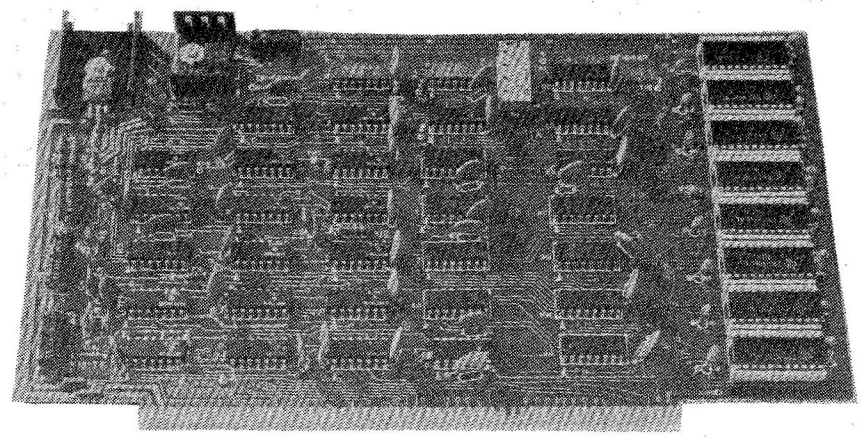
Keeping up with its innovative tradition, MITS has recently announced several new products which will greatly expand the capabilities of the Altair Computer system.



680-b Universal I/O Board



88 - Multiplexer



88 - S 4k Memory Board

Letters to the Editor

Mr. Larry B. Cottrill of Des Moines, Iowa, sent in the following comments on Henry Arnold's Biorhythm Program (Computer Notes, July, 1976).

The calculations of Y1 and Y2 are incomplete. The program as listed on page ten of the July issue assumes that any year which is an integer multiple of four is a leap year. The correct leap year rule is: any year 'evenly' divisible by four is a leap year UNLESS it is 'evenly' divisible by 100 (a 'century' year), BUT it is still a leap year if it is 'evenly' divisible by 400. To correct the program, rewrite the lines shown here:

```
5000 IF INT(Y1/4)*4<>Y1 THEN 5200 ;NOT A LEAP YEAR
5100 IF INT(Y1/100)*100=Y1 AND INT(Y1/400)*400<>Y1 THEN 5200 ;NOT A LEAP YR
5150 L1=1: GOTO 5300
5200 L1=0
5300 IF INT(Y2/4)*4<>Y2 THEN 5500 ;NOT A LEAP YEAR
5400 IF INT(Y2/100)*100=Y2 AND INT(Y2/400)*400<>Y2 THEN 5500 ;NOT A LEAP YR
5450 L2=1: GOTO 5600
5500 L2=0
  .
  .
  .
10510 IF INT(Y2/4)*4<>Y2 THEN 10530 ;NOT A LEAP YEAR
10520 IF INT(Y2/100)*100=Y2 AND INT(Y2/400)*400<>Y2 THEN 10530 ;NOT A LEAP YR
10525 L2=1: GOTO 10600
```

Note that lines 5200, 5500 and 10530 need not be re-written; lines 5150, 5450 and 10525 are added lines. These changes will allow the program to work correctly for persons born before March 1, 1900. The leap-year rule stated above is correct for any year later than 1582, when the Gregorian calendar was adopted as a long-needed reform.

Dear Ed.,

In the last issue of Computer Notes, you mentioned a number of magazines interested in articles on microcomputers (and willing to pay for them). We are too, i.e., seeking good articles and willing to pay. In particular, we're interested in first person experience building computer kits and peripherals, and then getting them operational. But even more, we're trying to focus on "what do you do with it after it's built?" That is, applications. Things like a file system for LP records, menu/shopping planning for various tasks and dietary requirements, kinetic video art, and, of course, games. But challenging games, cybernetic games, learning games.

Contributions should be sent to Ms. Burchenal Green, Editor, Creative Computing, P.O. Box 789-M, Morristown, N.J., 07960.

Sincerely,
David H. Ahl,
Publisher

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customer service news

By Gale Schonfeld

This month the Repair Department has asked me to relay the following message to you:

WARRANTY ON MITS PRODUCTS

The warranty on kits is 90 days for parts. Labor is charged at $22.00 per hour for all computer mainframes and related products. The warranty on assembled items is 90 days for parts and labor.

For detailed information on product warranty, please check your manuals. Remember - the warranty does not cover postage and handling to and from the MITS factory.

HOW TO SHIP UNITS IN FOR REPAIR

Packing - Make sure when packing items to be returned for repair that all accessories are secured in place and that they are not "floating" inside or outside of the mainframe. Transformers should be bolted down or shipped separately, peripheral boards should be secured in their card guides and edge connectors, or packed in a separate box, disk drives must have the "block" secured in place, etc. Damage resulting from poor packing or packaging will automatically void your warranty. The Repair Department will advise you of any packing damage before repair action is begun.

Packaging - If at all possible, items should be shipped in the original MITS box, padded well with newspaper or styrofoam beads. Styrofoam corner pads should be used to protect mainframes and terminals. Double boxing is preferred.

Damages caused by the shipping agent - If an item received appears to have been damaged in shipment, the Repair Department will immediately contact the customer so that appropriate action may be taken for claims purposes.

Mailing labels - Please be sure that your mailing label reads "ATTN: Repair Department". We do have several departments which receive in-coming packages and unnecessary delays can be caused by misrouting.

Enclose a letter - Please be sure to enclose a letter explaining the problems you are having with your equipment. Examples of these problems would also be helpful. Also, please remember to state who the actual owner of the computer or peripherals is (the owner, by our records, is the person or company listed in the "sold to" address on your invoice). We ask this in order to prevent unnecessary charges due to lack of information on warranties.

CHARGES

Labor Charges - Labor charges are rated at $22.00 per hour for all mainframes and related products.

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COMPUTER NOTES

Editor	Andrea Lewis
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Trekking with the Altair

By Steve Lowe of Microsystems, Springfield, VA

At the recent "STARTREK EXPO" held at the Hyatt Regency Hotel in Washington, D.C., MICROSYSTEMS was on hand with an impressive display of ALTAIR computers to introduce "Trekies" to the world of microcomputers. Several ALTAIR computer systems were displayed featuring a disk system, a talking ALTAIR, a T.V. Dazzler system using an Advent 4' x 6' Videobeam T.V., and a game system using a second Videobeam T.V. as a terminal.

Throughout the three day event, each of the systems proved their worth in attracting and holding convention-goers' attention while the MICROSYSTEMS staff answered questions and provided information to interested people. Many had no idea that microcomputers were so versatile and later dropped in at the MICROSYSTEMS showroom for more in-depth demonstrations of MITS computers and ALTAIR BASIC.

One highlight of the show for the MICROSYSTEMS crew was a visit to their display by several of the original stars of the STARTREK T.V. series. George Takei, who plays Mr. Sulu in the series, was lured into the display room and tried out different versions of STARTREK games in front of a large crowd. During one game where the Enterprise engages in combat with a similarly armed Klingon Vessel, George asked, "Do we have to fight? Why can't we negotiate?" Moments later a moan of anguish engulfed the room as the crowd watched the Klingon ship out-maneuver and destroy the USS Enterprise. George redeemed himself, however, by winning his second battle. A newcomer to the world of microcomputers, he admitted that he could understand the fascination that made the MICROSYSTEMS display such a popular attraction at the show. Even before Gene Roddenberry (the producer of Star Trek) spoke later that day about the impact of computers on the future of humanity, MICROSYSTEMS had been proving that thanks to MITS, the impact of computers is already being felt around the world.

Moments before the Klingon's destroyed the Enterprise, George Takei (Mr. Sulu from the Star Trek T.V. series) pauses to ask the MICROSYSTEMS crew about "the possibility of negotiating with the Klingon vessel."

Book Review

By Linda Blocki

The Compleat Computer

RIDDLE: What does a medical center, the Senate Watergate Committee's investigative team and a Tibetan monastery have in common? ANSWER: a computer. Surprised? Thanks to new electronic developments, the use of computers is quickly expanding to practically all areas of everyday American life.

Information about computers is no longer confined to complicated articles by mathematicians and data processors. Many noncomputer specialists are now doing some interesting research and writing, which is gradually replacing the public's confusion about all that hardware and software with beneficial information that anyone can understand.

The Compleat Computer (1976), a carefully compiled collection of over 100 informative and sometimes humorous articles by noncomputer specialists, seems to be the best publication so far to help expose people to the many diverse opinions about the use of computers. Author Dennie Van Tassel, user liaison in the computer center at UCSC and collector of computer miscellany, has filled his paperback book with a wide variety of selections from fiction, poetry, newspapers, cartoons, and advertising as well as more detailed articles that concern the computer specialists. Such well-known noncomputer experts as Norman Cousins, Ray Bradbury and Isaac Assimov are just a few of the writers whose articles appear throughout the book.

Some of the different areas the articles cover include the story of a fully computerized poison control center in a children's hospital in Missouri, a fictional account of a Tibetan monastery that used a Mark V computer to compile a list of all the possible names of God and a computer which acted as a key "member" of the Senate Watergate investigative team by spewing out minute facts about any witness in a fraction of a second.

In order to include as much material as possible, Van Tassel has capsulized the longer articles and selected only the "tastiest tidbits" for publication. His extensive references following each article are helpful to the interested reader who wishes to pursue a topic in greater depth. After each well-organized section of the book, a long list of questions and exercises is included to further aid the reader in exploring other various opinions about the use of computers.

The book is divided into nine sections starting with three introductory chapters--"In the Beginning," "How Computers Do It" and "The Software"--which discuss the basics of computer operation. Articles appearing in this first section include "The Development of Automatic Computing," "Computer Games People Play" and "Technology, McDonald's Collide as Students Best Burger Bonanza," a humorous article describing how Cal Tech students used an IBM computer to print out 1.2 million entry blanks and win a McDonald's contest.

Continued on Page Fourteen

– Continued from Page One –

the effect is a very dark image. When the columns are printed farther apart, the image appears lighter.

The 7000 is controlled by using a single port on an 88-4PIO parallel interface board. One section of the port provides the eight bits of information to be printed, and the other section provides control.

The control signals to the 7000 are: (1) MOTOR ON, which starts the motor running while the print head remains disengaged, (2) PRINT, which engages the print head to begin traveling across the page and (3) LINE FEED, which causes a line feed with no print head movement.

The control signals from the 7000 are: (1) CT or character timing pulse. The first pulse defines the left-hand margin once the print head has begun to move, (2) DT or dot timing pulse. There are eight dot pulses for each character pulse.

Each time a new column of information is to be printed, the appropriate data bits are forced low (logic "0") by the 4PIO. Each low data line causes the related printhead electrode to discharge to the paper. This produces one dot. In all there are more than 500 eight-dot columns in a line.

To print characters, seven electrodes are used to provide a one-dot space between lines. In the plot mode all eight electrodes are used so that there's no space between the lines that make up a plot.

The software required to use the Altair 7ØØØ Graphics/Printer as a line printer has been integrated into the BASIC interpreter. In order to list or print using the 7ØØØ, the LPRINT or LLIST commands are used. In order to change the character size, an LPRINT command must be issued which includes one of the following three special characters:

CHR$(1) prints 80 characters/line
CHR$(2) prints 40 characters/line
CHR$(3) prints 26 characters/line

Example:

```
LPRINT CHR$(1);"TEST SMALL CHARACTERS"
LPRINT CHR$(2);"TEST MEDIUM CHARACTERS"
LPRINT CHR$(3);"TEST LARGE CHARACTERS"
```

produces the following output:

```
TEST SMALL CHARACTERS
TEST MEDIUM CHARACTERS
TEST LARGE CHARACTERS
```


Note: If a new character size is not requested, the most recently requested character size will be used.

Except for one assembly language subroutine, the software for using the Altair 7ØØØ Graphics/Printer as a plotter is written entirely in BASIC language. This will allow the user to make his own custom modifications to the standard software. It will also allow him to save room in memory by removing subroutines that are not required.

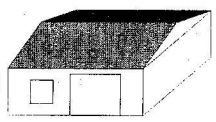
The image to be printed is stored in memory in a buffer with each bit representing a dot in the picture. If the bit is turned on, the corresponding dot is present. If the bit is turned off, the corresponding dot is absent. A 256 byte segment of memory represents the 8 rows of 256 dots printed on one pass of the print head. In order to cause this 8 by 256 segment to be printed, a single call to the assembly language routine is required.

Since an 8 by 256 dot picture is far too small to be of any practical use, the plot routine uses a number of these 8 by 256 elements to compose a picture. The standard number is 32, and this requires an 8K buffer for the image. The user may increase or decrease this number by altering a single BASIC statement as his needs require or his memory permits.

There are BASIC subroutines for:

1) performing initialization - setting buffer size, location, etc.
2) printing the entire buffer
3) clearing the buffer
4) marking a dot
5) writing a character
6) writing a string for label
7) calculating scaling factors
8) plotting a point
9) drawing a line

Here is some sample output:



7000 Graphics/Printer Specifications:

Price and availability:	$785, 60 days
Printing medium:	Electrosensitive paper (5 inches wide)
Horizontal resolution:	A. Internal timing--80 dots/inch B. External timing--better than 128 dots/inch
Vertical resolution:	65 dots/inch
Printhead speed:	0.0175 inches/msec.± 0.1%
Timing markers:	A. Every 1/80 inch of printhead travel (DT) B. Every 1/10 inch of printhead travel (CT)
Plotting speed:	Two lines per second, 8 dots vertical
Input raster:	Eight-bit parallel
Power:	115V AC. 36 VA
Weight:	14 lbs.
Interface:	1 PIO Port (88-4PIO or parallel port on 680b Universal I/O Board)

The 680b Universal I/O Card:

The 680b Universal I/O card provides two parallel ports and one serial port to greatly enhance the I/O capabilities of the Altair 680b while occupying only one slot on the expander board.

Parallel Ports

The design of the Universal I/O's two parallel ports is based upon a Peripheral Interface Adapter (PIA). The PIA contains all control and data registers, thus most options are software selectable. These options include data direction (each data line can act as an input or an output), and interrupt/control structure. The Universal I/O can be expanded up to two parallel ports.

Parallel Port Selection:

Each Universal I/O card requires 16 address lines. Hardware sets the upper 8 address lines (A15 to A8) to FØ (hexadecimal) for all I/O ports. These addresses are FØXX.

Address lines A7 through A4 and their complements $\overline{A7}$ through $\overline{A4}$ are user-selectable. With these addresses there are 16 different address locations for the Universal I/O (4 addresses are reserved for future use).

Address lines A3 and A2 select between 3 ports. A3 addresses the parallel ports or the serial port. A2 selects a particular parallel port.

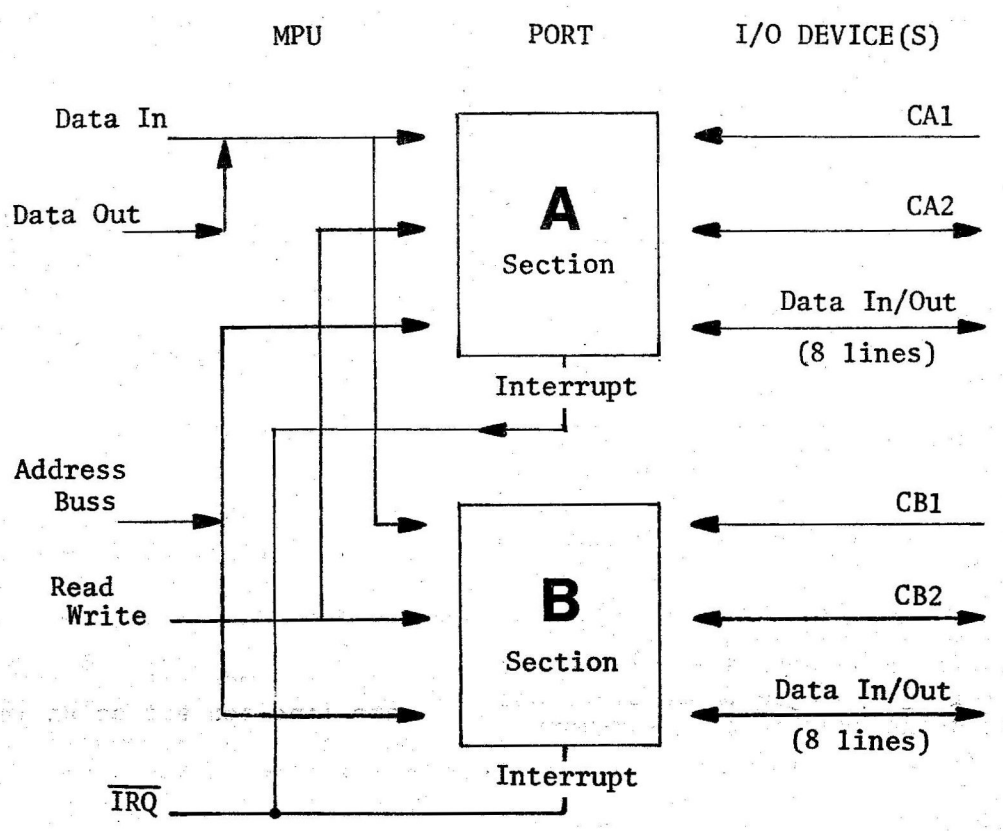
Each PIA contains 2 sections. Sections A and B each contain two channels, control status channel and data-data direction channel. Address lines AØ and A1 enable the selection of port section, A or B, and the selection of control status channel or data channel. If the two parallel ports are addressed at F008 and F00C, the port, section and channel addresses would appear as follows:

(Refer to Figure One)

Figure One

ADDRESS	IC	SECTION	CHANNEL
F008	B	A	CONTROL/STATUS
F009			DATA-DDR
F00A		B	CONTROL/STATUS
F00B			DATA-DDR
F00C	A	A	CONTROL/STATUS
F00D			DATA-DDR
F00E		B	CONTROL/STATUS
F00F			DATA-DDR

The following block diagram illustrates the internal structure of a PIA.



(Refer also to "Software Initialization of Parallel and Serial I/O Boards" by Patrick Godding, Computer Notes, June, 1976, pp. 14-17.)

The Universal I/O with only one PIA parallel port can handle two inputs (such as a paper tape reader or keyboard) or two output devices (such as a paper tape punch and printer) or any combination of custom applications. A Universal I/O with two PIA parallel ports has 32 data lines (each group of eight is individually selectable). All data lines are fully TTL compatible. Eight of the 16 lines are capable of directly driving the base of a transistor switch (1.5v at 1ma).

Serial Port

The design of the Universal I/O's serial port is based upon an Asynchronous Communications Interface Adapter (ACIA). The ACIA allows serial data to be taken in on its receive line and transfers the data onto the Data Bus, or data can be entered from the data bus into the ACIA and then sent out the transmit data line in serial form.

The ACIA contains both control and status registers. Five control lines allow maximum utilization of sophisticated terminals. The five control lines are: (1) transmit data, (2) receive data, (3) data carrier detect, (4) clear to send and (5) request to send.

The 8-bit Status Register allows for greater control and handshaking ability by indicating received data available, transmitter buffer empty, carrier detect, clear to send, framing error, received data overflow, parity error, and interrupt request.

All lines are switch-selectable for RS-232, TTL levels or 20 milliamp current loop (TTY). The serial port is programmable for nine or ten bit transmission as follows:

a. 7 data bits + parity bit (odd, even, or none) + 1 or 2 stop bits;

b. 8 data bits + 1 or 2 stop bits;

c. 8 data bits + 1 stop bit + parity bit (odd or even)

The transmit and receive interrupts enable or disable under software control. The Universal I/O provides an onboard, crystal-controlled clock that allows user selection for any of 13 baud rates by positioning a dip switch.

The Selectable Baud rates are:

50	2400	300
75	9600	150
134.5	4800	110
200	1800	
600	1200	

Universal I/O Board Specifications:

Level Selection: Switch selectable, TTL, RS232, TTY

Baud rate generator (ACIA): Crystal-controlled CMOS Divider

Device Connection: (fully expanded) 12 conductor cable, 10-pin removable connector on board and 25 pin connector (ACIA). Three removable flat cables with a 24-pin plug on the board and a 25-pin connector passed through the back panel (for PIAs and other parallel interface).

680b Mb slots: One

Power: +5 volt at approximately 350 milliamps fully expanded. Typically 27 milliamps @ +16 volts. Typically 10 milliamps @ -16 volts.

Bit Configuration: Software selectable for seven or eight bits, one or two stop bits and odd or even parity PIA.

88-S4K Memory Board:

An ideal addition to the Altair 8800 series computer is the 88-S4K Synchronous 4K Memory Board, which has many outstanding features including totally synchronous design logic. This means the memory relies solely on the CPU for timing signals - no single shots and no critical on-board timing.

-Continued on Page Nine-

Troubleshooting the 680b

by Rich Haber

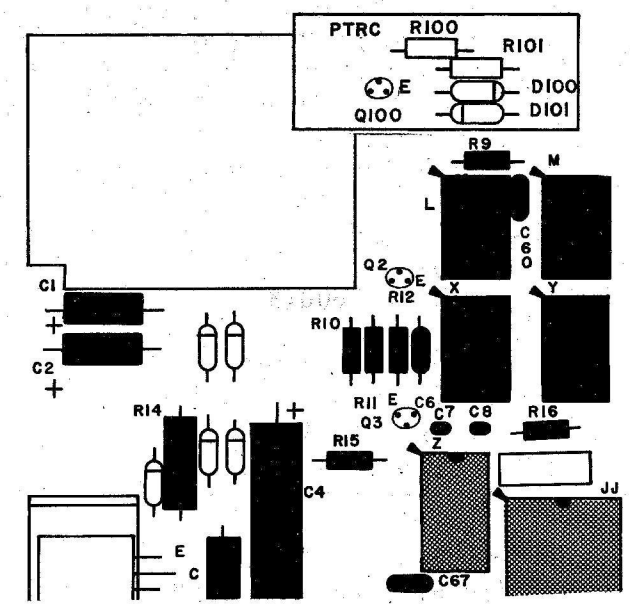


Figure 1.

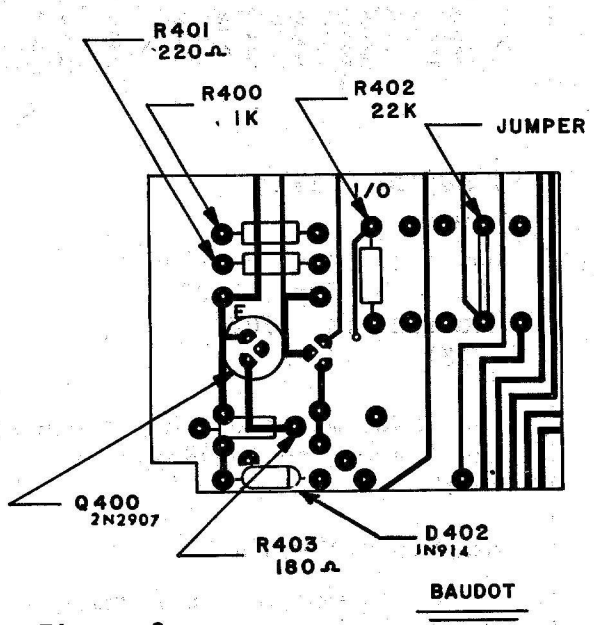


Figure 2.

We have been very impressed in the repair department by how few 680b's have been sent back to us. Kit builders have been doing a really good job assembling and troubleshooting their units. If you are having any trouble with your 680b, the troubleshooting aids on pages 17-19 in the Theory of Operation Manual will help you track down some of the most common problems.

Apparently not everybody received or noticed the errata sheet explaining that Q2 and Q3 and Q100 were silkscreened incorrectly on some of the main boards. The emitters were marked where the collectors should be and vice versa. The correct positioning for these transistors is shown in Figure 1. There was also an error on page 30 of the Assembly Manual and page 10 of the Operator's Manual concerning the Baudot interface. The values for R401 and R400 were reversed and a diode (D402) was left out. See Figure 2 for the correct configuration.

Here is a list of some common problems with the 680b and how to track down the causes.

680b Troubleshooting

1. All address lights except A0 lit.

   This indicates that the computer is locked in the reset mode. This can be verified if pin 40 of the MPU ($\overline{RES}$) is LOW. Probable causes:

   a. Q2 and Q3 are in backwards (silkscreen shows C & E reversed).
   b. Solder bridge on transistor lands.
   c. No phase 1 clock signal to IC K pin 10 on front panel. If true, then check pin 2 of IC pp.
   d. Bus line 54 shorted.

2. MPU always running.

   This can be verified if pin 2 of MPU ($\overline{HALT}$) is HIGH. Probable causes:

   a. No Ø2 phase 2 clock signal to IC K pin 2 to retrigger the one-shot; if so, then check PP-4.
   b. IC I or K defective (check logic).
   c. Q4 or Q5 in backwards, shorted or defective.

3. Can't deposit.

   a. Make sure RAMs are strapped to the address you want.
   b. Check to see if pin 34 of the MPU (R/$\overline{W}$) goes LOW when the deposit switch is toggled. If 34 won't go LOW, look at I-12 on front panel and trace back.
   c. $\overline{BA}$ (pin 7 of MPU) should be HIGH.
   d. $\overline{IRQ}$ (pin 4 of MPU) should be HIGH.
   e. IC M pin 12 should be HIGH for read, pulse LOW for deposit. Does Ø2 appear at pins 1 and 2?
   f. AA-8 should be LOW. If not, and all AA inputs are HIGH, look for a short on this line.
   g. Check for solder bridges on RAMs.

4. Can't deposit at any one bit.

   First interchange RAMs and see if bad bit changes. If it does, then the RAM is bad. If not, make the following checks on the bad bit (leftmost RAM is bit 0):

   a. Pin 13 should be LOW.
   b. Pin 10 should be HIGH.
   c. Pin 3 should be HIGH to read and pulse LOW to write.
   d. Is data appearing at DI (Pin 11)? Is data appearing at DO (Pin 12)? If not, check logic at NAND gate and inverter on output (pin 12). Outputs of NAND gates should be HIGH for a "1" and LOW for a "0". Failure here could involve laborious tracing for solder bridges or shorted IC.

- Continued -

altair 8800b
Assembly Manual Corrections:

(Display/Control Board)

#1 - Capacitor C7 should be ommitted and resistor R75 should be replaced by a jumper wire. This filter circuit is not necessary since it will attenuate the Ø2 input to IC S1-3 too much.

#2 - When installing the resistor pack (page 5-24) it is necessary to clip off the last three leads at the end furthest from the dot on the resistor pack. There are no holes on the PC board for these leads and these three resistors are unused.

5. Defective monitor.

Check pin 14 of PROM (chip select). It should go LOW when reset is toggled. If not, check to see that: DD8 is LOW, GG13 is HIGH, HH4 is LOW and NN40 is LOW while resetting.

If the monitor fails to print a period, it is occasionally due to two or more addresses being shorted together. Toggle each address switch separately to see if the LED lights. If a LED fails to light, position all the address switches up. If the LED comes on, then there is a short between addresses. You can isolate which one by putting the switches down one by one.

I/O problems.

Pins 2 and 6 of the ACIA should be HIGH after initializing the monitor (with 680b in terminal option), otherwise a short is indicated. Pins 3 and 4 should have a square wave signal equal to 16 times the baud rate; look for a .568 msec. period for 110 baud, .208 msec. for 300 baud. NOTE: R15 should be 1K ohm instead of 4.7K. Do not bother to replace it unless the voltage at the right side of R15 is below TTL levels. If the voltage is very low, IC Z is probably bad.

The most common causes of problems on units we have received have been:

a. Solder bridges and cold solder joints (especially on 100 pin connector)
b. Incorrect parts placement
c. Incorrect hardwire strapping
d. IC pins bent under chip

I would like to recall your attention to the problem mentioned in the June Computer Notes ("Altair 680b Hardware Notes," page 9). If the MPU is given an invalid instruction to execute, it cannot be reset through the front panel switch. Instead, power must be turned off and on and then RESET must be activated, thereby erasing memory. To correct this, do the simple modification that is outlined in the article.

Here is a convenient check list of logic levels for troubleshooting:

Chip	ID	Pin	Label	Status (MPU Stopped)
MPU	NN	2	$\overline{\text{HALT}}$	LOW
		3	Ø1 (phase 1 clock)	Ø1
		4	$\overline{\text{IRQ}}$ (interrupt request)	HIGH
		5	VMA (valid memory)	LOW
		6	$\overline{\text{NMI}}$ (non maskable interrupt)	HIGH
		7	BA (bus available)	HIGH
		34	R/W (read/write)	HIGH (pulses LOW during deposit)
		37	Ø2 (phase 2 clock)	Ø2
		40	RES (reset)	HIGH
ACIA	JJ	3&4	clock square wave frequency = 16 x baud rate	
		9	$\overline{\text{CS2}}$ (chip select 2)	LOW
		10	SS1	HIGH
		11	RS (register select)	tied to A0
		13	R/W (read/write)	HIGH
		14	enable	Ø2
		7	$\overline{\text{IRQ}}$	HIGH
RAMs	C-K	3	R/W-P (read/write-prime)	HIGH (pulses LOW during deposit)
		10	VCC	HIGH
		11	DI (data in)	same as front panel switches
		12	DO (data out)	same as front panel lights
		13	$\overline{\text{CS}}$ (chip select)	LOW when addressed
PROM	T-V	14	$\overline{\text{CS}}$ (chip select)	LOW when addressed

Continued on Page Ten

Altair Users

Larry Landsuerk
2320 N. 56th Lane
Fort Smith, Arkansas 72901

Ronald W. Moore
A Div. USS America CV66
FPO, New York 09501

Robert M. White
5240 Kootenai St.
Boise, Idaho 83705

Carl Knipp
Box #1
Cary, IL 60013

New Address for:
Capt. James K. Bostick
Tuslog DET II
PSC Box 2324
APO, New York 09224

Jim Henley
420 Bankcroft Ct., #8
Rockford, IL 61107

Computer Clubs

Houston Texas

HAMCC
David M. Fogg, President
4223 S.W. Fwy., #203
Houston, TX 77027
(713) 626-2935

The HAMCC meets on the second Friday and the fourth Tuesday of each month.

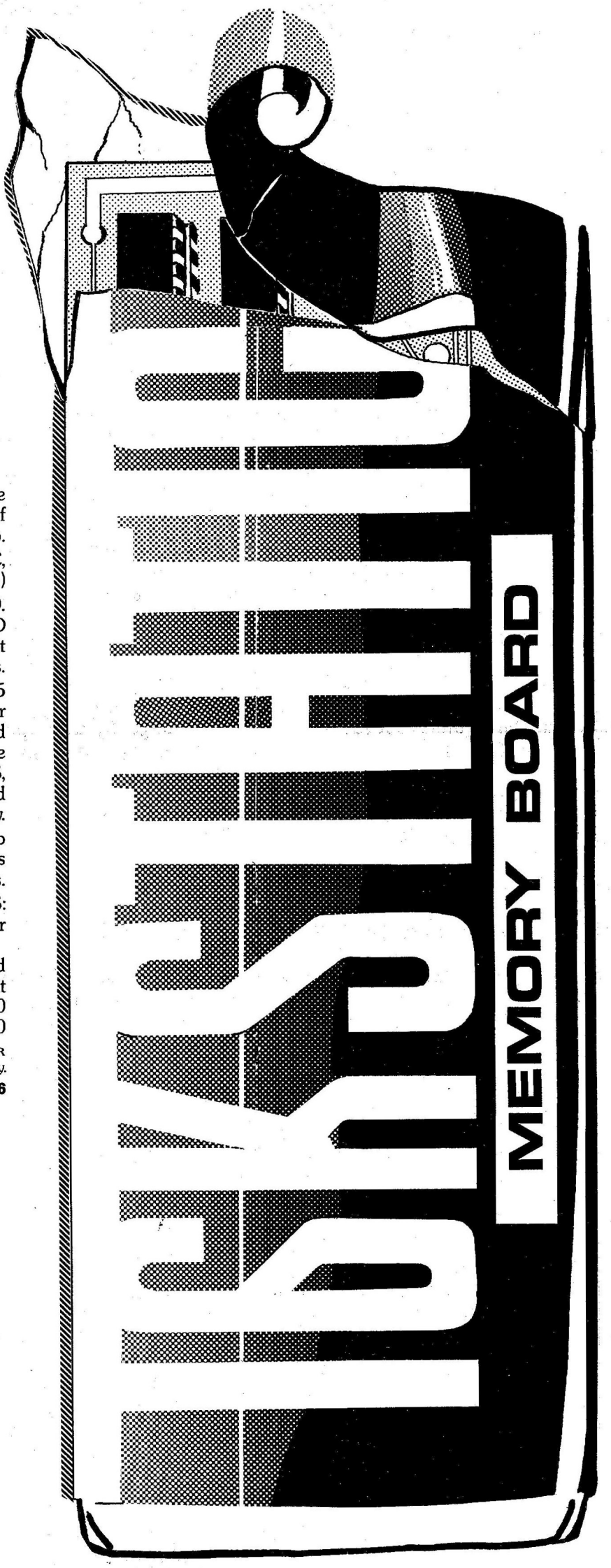
Rockford, Illinois

Anyone interested in forming a club in the Rockford, Illinois, area should contact:

Jim Henley
420 Bancroft Ct., #8
Rockford, IL 51107
1-815-399-6558

HARD WARE

Something Sweet for your altair™ 680-b



MITS is pleased to announce the development of a 16K static card for the Altair 680b. With an access time of 215 nanoseconds and low power consumption of 5 watts, we feel that this is an excellent addition to the Altair 680b.

To sweeten the pot even more, we are including a free copy of Altair 680 BASIC, assembler, and text editor on paper tape. ($275 value)

Altair 680 BASIC is identical to the 8K BASIC developed for the Altair 8800. Features include Boolean operators, the ability to read or write a byte from any I/O port or memory location, multiple statements per line, and the ability to interrupt program execution and then continue after the examination of variable values.

Other features of Altair 680 BASIC include variable length strings (up to 255 characters), with LEFT$, RIGHT$ and MID$ functions, a concatenation operator and VAL and STR$ to convert between strings and numbers. Both string and numeric arrays of up to 30 dimensions can be used. Nesting of loops and subroutine calls is limited only by available memory. Intrinsic functions include: SIN, COS, TAN, LOG, EXP, SQR, SGN, ABS, INT, FRE, RND and POS, in addition to TAB and SPC in PRINT statements. Altair 680 BASIC takes 7K bytes of memory.

MITS has also developed an expander card for the Altair 680b that lets you add up to three boards inside the main case. Read "Computer Notes" for announcements of additional Altair 680b boards.

PRICES:

Altair 680-BSM, 16K Static Memory Board, including Altair 680 BASIC, assembler and text editor . . . . . $685.00 kit
$865.00 assembled

Altair 680-MB Expander Card with one Edge Connector . . . . . $24.00 kit

Altair 680 BASIC (purchased separately) $200.00

Altair 680 assembler and text editor (purchased separately) . . . . . $ 75.00

PRICE APPLIES ONLY TO PURCHASERS OF ALTAIR 680b COMPUTER

Prices, specifications subject to change. Allow 30-60 days for delivery.

MITS, Inc. 2450 Alamo S.E./Albuquerque, New Mexico 87106

mits

– Continued from Page Five –

There are no wait states so that the CPU runs at maximum speed.

The 88-S4K provides 4,096 bytes of Random Access Memory while consuming very low power. Each board contains memory protect circuitry and address selection circuitry for any one of 16 starting locations in increments of 4K. The entire 4,096 bytes of memory can be protected by switching to PROTECT. A DIP switch is used for board selection with no hardwire jumpers, and test points have been installed at important signal outputs for ease of checkout and troubleshooting. Ferrite beads are used on all common supply lines for noise isolation.

For ease of assembly, an epoxy solder mask on areas not to be soldered has been added, as well as sockets for all memory ICs, which provide easy installation and removal of the ICs. Included with the 88-S4K is a well-documented manual with detailed theory and troubleshooting sections and step-by-step assembly instructions.

88-S4K SPECIFICATIONS

RAM Access Time: 200-300 ns.

Power Requirement
(worst case):

+5V current - 450 ma (max.)
+12V current - 290 ma (max.)
+12V current (unselected) -
10 ma (max.)

Memory Array: 4,096 8-bit words

Dimensions: 10" x 5"

Altair Slots: One

Price: $155.00 kit, $255.00 assem.

Availability: Within 60 days of order.

The 88-MUX (24-Channel Multiplexer):

The 88-MUX, companion card to the 88-Analog/Digital Converter (88-ADC--see page 8 of the August issue of C.N.), will expand the input capacity of the 88-ADC for applications requiring a large number of analog inputs.

The 88-ADC is actually a stand-alone card for many systems, because it contains an on-board 8-channel multiplexer. However, for a majority of system layouts, the real potential of the ADC and MUX conversion system lies in the ability of the MUX to process more than eight signals. By using four 88-MUX cards, it is possible to process up to 96 analog signals!

Another advantage of using the 88-MUX is the optional differential input. With simple modifications, the card can be set up to handle a differential input on each channel.

As a bonus, the gain and scale factoring of each channel can be set independently, giving extreme flexibility in system design. Input filtering can also be added to provide the desired roll-off characteristics.

An appropriate interface cable is provided with each ADC and MUX pair. (For more than one 88-MUX per system, a cable is required for each MUX card.)

Specifications for the 88-MUX (24-Channel Multiplexer):

Price: $319, assembled only.

Availability: within 60 days of order.

Gain: Up to 1000

Input Impedance: 1000 megohms

Offset: 5MV (max.)

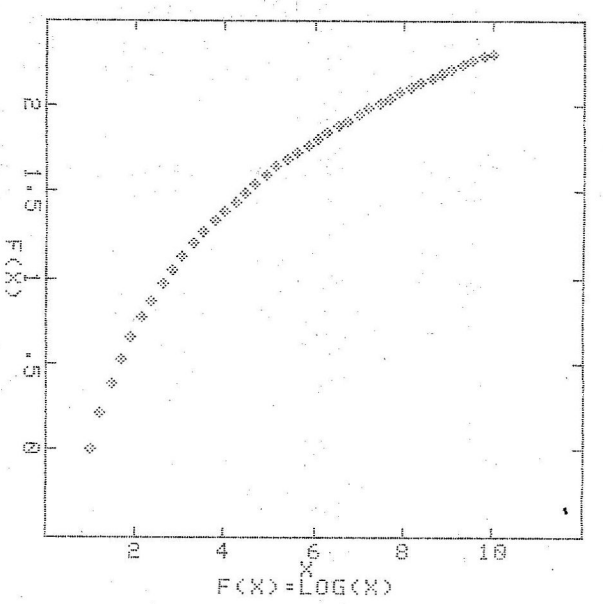
Input Signal
Level: (-4 to +10v)
(-10 to +4v)
(-5 to +5v)

Settling Time
to .01%: 15 microseconds (max.)

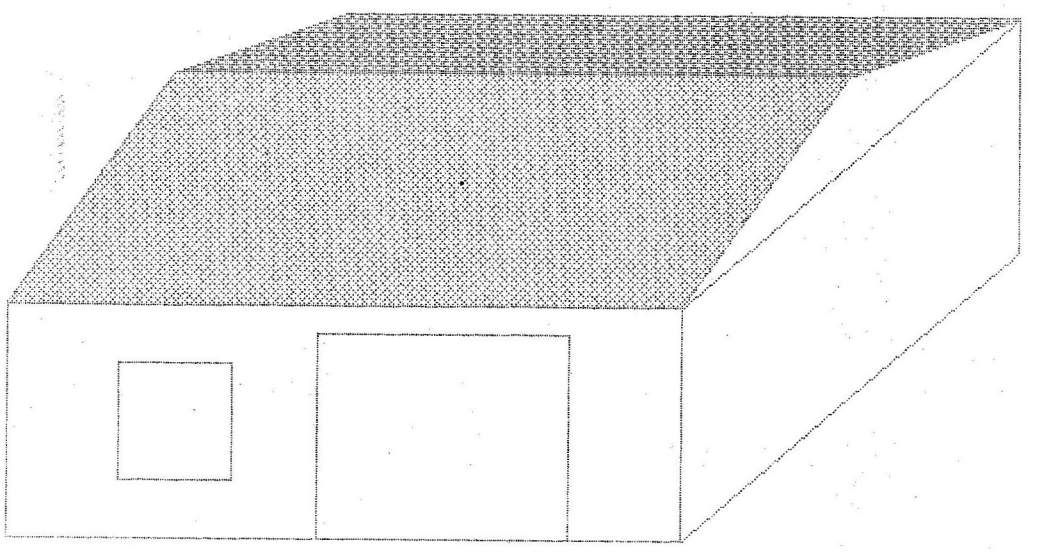
P.S. requirements: +5v@40MA
+15v@180MA
-15v@180MA

(See Computer Notes, August, 1976, page 8, for specifications on the 88 A-to-D Converter.)

Example of Program printed by Graphics Printer.(73% of full size.)



Example of Graph printed by 7000 Graphics Printer.(73% of full size.)



Example of 3-Dimensional House projected by 7000 Graphics Printer. (73% of full size.)

software corrections

Users have discovered the following mistakes in two of our software programs:

#2-3-761, page 18:

Memory location 1 042 166 should read 1 042 301

Page 31:

Memory location 2 015 014 should read 2 015 013

#6-1-763, Line 570:

A=FNR(NØ5)+INT(NØ+5) : B=FNR(N1/2Ø)+ INT(N1/2Ø) : C=FNR9L2/5Ø)

should read A=FNR(NØ5)+INT(NØ/5) etc.

This change makes it possible to win the game.

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2450 Alamo SE

Albuquerque, NM 87106

505-243-7821

TROUBLESHOOTING

— Continued from Page Seven —

Here are three test programs that are useful in checking out your 680b.

Jump

0000	7E	jump	when running only A0 & 1 should be lit
1	00		
2	00		

Add Two Bytes

0000	86	LDA	
1	your choice of data		
2	C6	LDA B	
3	your choice of data		
4	1B	ABA	
5	B7	STAA	
6	00	LDC	
7	40		
8	7E	JMP	
9	00		
	when using front panel		
A	00		
	or		
9	FF		
	when using terminal		
A	AB		

Reset, run, stop and sum of data should appear at address 0040.

Echo Routine

reset and initialize ACIA	0000	86	
	1	03	
	2	B7	
	3	FO	
	4	00	
	5	86	
	6	D1	
	7	B7	
	8	FO	
	9	00	
check to see if a character has been received	A	B6	
	B	FO	;wait for data
	C	00	
	D	47	;rotate right
	E	24	;branch
	F	FA	
input data	0010	B6	
	1	FO	
	2	01	
check to see if ACIA ready to output	3	F6	
	4	FO	
	5	00	
	6	57	;rotate
	7	57	;rotate
	8	24	
	9	F9	
output data	0001A	B7	
	B	FO	
	C	01	
	D	20	
	E	EB	

jump to 0000
and type character

Should you need more help with your 680b, please feel free to call us. If you decide not to repair the unit yourself, please send it in. There is currently no backlog of 680b's in repair and return should be relatively prompt.

HAM on the side

By Wayne Cronin

As the only licensed ham at MITS, I've been elected to edit a new ham-oriented column for Computer Notes. I'll be using this space to pass along ideas for adapting computers (hopefully ours!) to ham purposes. That means I'll need lots of input from readers, and I'm sure many of you have some good ham applications ideas to share with us.

ASCII, HAMS, AND THE FCC

If you have your own computer system, you probably have some kind of I/O device that uses ASCII code. If you could use your terminal to key your rig, you could use your computer to get in on RTTY activity, or to communicate with another ham's computer via radio. Unfortunately, since current FCC regulations allow only Baudot code transmission, you have to use some kind of hardware or software code conversion scheme to accomplish either of these functions. This is a needless complication and a waste of processor power.

The only way to get the rules changed is to petition the FCC. If you're thinking of submitting a petition, here are a few things to think over first.

Any new rules changes should be general enough to allow us to take advantage of future advances in the state of the art automatically; we don't want to have to cut more red tape each time something new comes along. If a proposal for a rules change is too specific in its wording, we could be neatly backing ourselves into a corner.

As an example, let's suppose that the FCC adopted new regulations based on a petition by amateurs requesting the use of ASCII. This could be interpreted as prohibiting Baudot. If this happened, we would instantly lose compatibility with Baudot equipped DX stations, and hundreds of U.S. hams using older equipment would be forced to use the same type of hardware or software conversions we had hoped to avoid.

I really don't think that anybody would submit such a restrictive proposal (much less that the FCC would adopt it). This is just an extreme example of the dangers of hastily written, narrowly worded proposals.

If any of you are considering submitting a rules change request concerning the use of ASCII, I'd like to hear your suggestions for a generalized wording that would allow us to use ASCII and Baudot now and also leave a few "loopholes" for future developments. (Don't forget to consider the possible effects of the proposed new bandwidth regulations on HF computer communications.)

September Software Contest

By Stan Webb

The first place winner this month is Kenneth Aird with his FORTRAN Cross Assembler for the 680. This program is beautifully written and well documented. With the addition of this program, we now have three FORTRAN Cross Assemblers in our library. Consequently, we cannot accept any more programs of this type.

Second place goes to Keith Fischer for his BECO Text Editor. This program, written in Altair BASIC, is considerably more powerful than the BASIC Editor, and would be a valuable addition to a BASIC system. The user documentation is fairly good, but it lacks much program documentation.

Erik Mueller takes third place with his MINOL Interpreter. MINOL is a subset of BASIC designed to run in less than 4K of memory. This subset is very restrictive when compared to a large BASIC, but is undoubtedly easier to work with than machine language. This program was previously published in the April, 1976, issue of Dr. Dobb's Journal of Computer Calisthenics and Orthodontia.

Due to the lack of competition in the subroutine category, no prize will be awarded this month.

HAM SOFTWARE (and the lack of it)

If any of you have written ham applications software for 8080 or 6800 based machines, please consider submitting it to our software library. If I receive any programs that aren't excessively long, I'll try to get a listing into Computer Notes. Some of you may be able to contribute information that could be used as the basis for a ham software package. An example would be a set of mathematical formulas for predicting satellite orbits. Information like this made available through Computer Notes could result in a lot more programs for the library.

COMPUTER NETS?

If you know of any nets devoted to computer topics, please let me know, and I will spread the word. If you'd like to start a net, send me your suggestions for a band and time.

NEXT

Next month I'll talk a little about some of my own ideas for ham computers and software. I hope to have lots of your ideas to talk about also. Please write or call me at the MITS Repair Department with your comments and suggestions. 73.

AUTHOR'S COMMENT:

The library has a lot of material now, so I'd like to see our users put more effort into writing clean programs with good documentation. The programs that are neatly typed on our submission forms and that are well documented are more worthwhile to other users than those that are hastily done and have no documentation.

FIRST PLACE MAJOR PROGRAM

#9-1-761
Author: Kenneth Aird
Length: 41,000 bytes FORTRAN
Title: M6800 Cross Assembler
Very well written FORTRAN Cross Assembler for M6800.

SECOND PLACE MAJOR PROGRAM

#8-23-761
Author: Keith Fischer
Length: 150 lines Altair BASIC
Title: BECO
Powerful Text Editor.

THIRD PLACE MAJOR PROGRAM

#8-13-761
Author: Erik Mueller
Length: 7,000 (octal) bytes
Title: MINOL
Interpreter for a 4K subset of BASIC.

#8-9-761
Author: Alan Miller
Length: 200 lines Altair BASIC
Title: QUBIC
Plays 3D tic-tac-toe.

#8-10-761
Author: Alan Miller
Length: 7 lines Altair BASIC
Title: Numerical Integration
Numerical integration by Simpson's method and Trapezoidal Rule.

#8-16-761
Author: Roger Frank
Length: 7 lines Altair BASIC
Title: Memory Size
This program resets BASIC memory sizes without restarting (for 3-2 only).

#8-19-761
Author: Alan Miller
Length: 5 lines Altair BASIC
Title: ARCSIN
Program to compute arcsin and arccos.

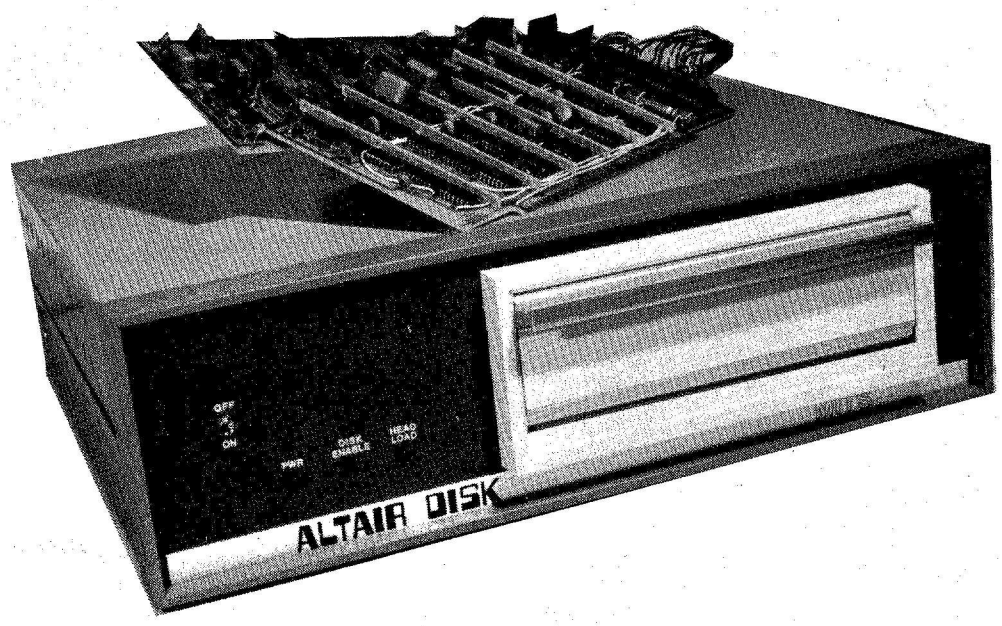
#8-26-761
Author: Roger Frank
Length: 22 lines Altair BASIC
Title: Memory Test
Program to test unused memory.

#8-27-761
Author: John Stanton
Length: 52 bytes
Title: 4PIO KBD/PTR Loader
Loads data into memory from keyboard and echoes it.

#8-28-761
Author: J. David Green
Length: 168 lines Altair BASIC
Title: Horse Racing
A horse racing game that involves betting on the races.

Technical Information

altair™ Floppy Disk (88-DCDD)



The 88-DCDD consists of the Disk Controller and one Disk Drive with an interconnect cable. The Disk Controller consists of 2 PC boards (over 60 ICs) that fit in the Altair chassis. The Disk Drive unit consists of a PERTEC FD-400, a power supply PC board, and a Buffer/Address/ Line Driver PC board. The Disk Controller converts the serial data to and from 8-bit parallel words (one word every 32 microseconds). The Disk Controller also controls all mechanical functions of the disk as well as presenting disk status to the computer.

Software and System Features

Altair Disk Extended BASIC is an enhanced version of Altair Extended BASIC with added capabilities for saving and loading programs, and for manipulating data files on disk.

Altair Disk Extended Basic uses random and sequential files for storing information on disk.

Utility software is included with Altair Disk Extended BASIC for copying diskettes, initializing blank diskettes, listing directories, etc.

Disk bootstrap loader is available on paper tape, cassette tape, or PROM (used with 88-PMC PROM Memory Card).

Hard sectored format (non IBM compatible) allows storage of over 300,000 data bytes.

Altair Disk Extended BASIC requires a minimum of 20K of RAM memory to operate in.

PROM Disk Bootstrap loader allows loading of Altair Disk Extended BASIC in less than 10 seconds from the time power is turned on.

Hardware

A. Description and Features

The Disk Controller, which acts as the interface between the Altair and the Disk Drives, consists of 2 PC boards that fit in the Altair chassis. They require 2 slots in the Altair, contain over 60 ICs, and connect to the Disk Drives via an 18 pair flat cable. The Controller can address up to 16 drives.

The Disk Drive Unit consists of a Pertec FD-400 drive in an Optima case 5½" high, 17" wide, and 17½" deep (same width and depth as the Altair 8800). Also in the Disk unit is a power supply and a Buffer/Address card for selecting the drive and interconnecting multiple disk systems. A fan is included to maintain low ambient temperature for continuous operation. The Disk Drive units interconnect to each other in daisy chain fashion and to the controller using 18 pair flat cables and DC-37 type 37-pin rectangular connectors.

B. Hardware Specifications

Access Time:
- Track to track: 10 ms.
- Head load and settle time: 45 ms.
- Average time to read or write: 400 ms.
- Worst case: 1135 ms.

Rotational speed: 360 RPM (166.7 ms/rev)

Tracks: 77 per disk

Sectoring: Hard sectored, 32 sectors per track, 5.2 ms/sector (non IBM compatible)

Data Transfer Rate: 250,000 bits/sec. (one 8-bit byte every 32 microseconds)

Maximum number of drives per system: 16

Data storage capacity: 310,000 bytes per disk

Data bytes per sector: 128

Data bytes per track: 4,096

Disk Drive head life: over 10,000 hours of diskette to head contact

Disk Drive MTBF: exceeds 4,000 hours

Disk Drive data reliability: not more than 1 in 10^9 soft (recoverable errors, 1 in 10^{12} hard (non-recoverable errors

Power:
- Controller: 1.1 amps at + 8V unregulated (from Altair bus)
- Disk Drive Unit: 110 watts 50/60 Hz 117/220 VAC

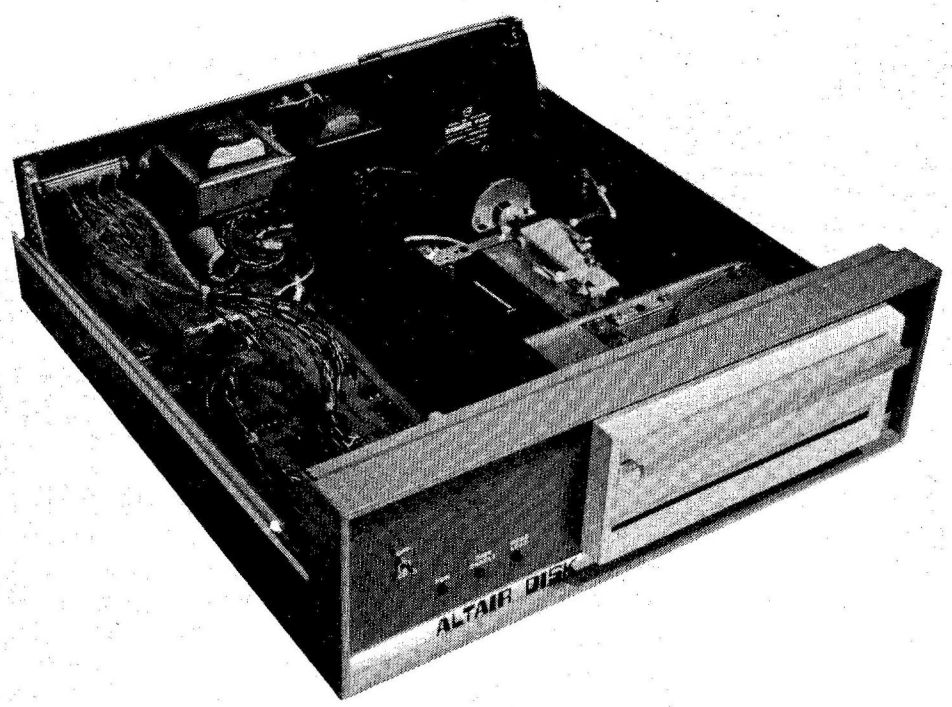
Diskette: Hard sectored, 32 sectors + index hole (Dysan #101, ITC #FD 32-100)

Disk Drive Unit Weight: 40 pounds

C. Operating Principle

The Disk Controller cards provide the interface between the Disk Drive Unit and the Altair bus. Serial read data from the disk is converted into 8-bit parallel form by the controller for transfer to memory via the CPU. Data is written on the disk by converting the 8-bit bytes outputted from the Altair CPU to serial form. All read and write data is transferred one byte at a time through the CPU.

Disk Controller Board #1 controls I/O address selection, sector counting, read data, and disk status. Disk Controller Board #2 controls disk drive addressing, write data, and disk drive functions.



Ordering information:

1. 88-DCDD

   Includes:
   - Set of controller cards
   - 1 Disk Drive Unit
   - 1 interconnect cable—6 ft. long
   - 1 Assembly and Operators Manual
   - 1 Disk Extended BASIC Manual
   - 1 Blank Diskette

2. 88-DISC

   Includes:
   - 1 Disk Drive Unit (117 VAC unless otherwise requested)
   - 1 Interconnect cable—6 ft. long
   - 1 Blank Diskette

3. Altair Disk Extended BASIC
   Requires a minimum 20K of memory for operation.

   Includes:
   - Altair Disk Extended BASIC on diskette
   - Altair Disk Extended BASIC Manual
   - Paper tape or cassette magnetic tape bootstrap loader (specify when ordering)

4. Disk Bootstrap Loader on PROM:
   Order 88-PMC (PROM Memory Card) and DBL PROM (PROM programmed with disk bootstrap loader routine)

5. Manuals only:
   - Disk Hardware Manual
   - Altair Disk Extended BASIC Manual

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2450 Alamo S.E. / Albuquerque, New Mexico 87106

altair ambassadors: MITS, Money, and You

By Mike Hunter

MITS, the originator and leader of the personal computing revolution, has developed a program to further extend support to those Altair users living in regions where Altair retail centers presently do not exist. The Altair Ambassador program will offer qualified individuals the opportunity to be local MITS Altair representatives in cities where computing interest is large, yet the likelihood of having an Altair dealership is small due to the relative size of the community. Thus, the Altair Ambassador will be able to give MITS support through the selling and servicing of Altair computing equipment, for which he will receive a commission on each sale, and be able to do so using his home as his place of business! Personal computing will become even more personal, for the local MITS representative will be a member of your community--perhaps even yourself!

If you live in a community where an Altair retail center is not available and you are an Altair System owner, you have met the first requirement on the way to becoming an Altair Ambassador. Another criterion is that the Ambassador have a working knowledge of MITS hardware and software so that he may offer technical assistance and repair capabilities to other Altair users.

MITS will conduct weekend training sessions for potential ambassadors which will include discussions of software capabilities, repair techniques, product scope, and sales techniques. Each applicant will be required to attend one weekend training session at his expense. Upon notification of his acceptance into the program, the Ambassador will receive a program package including business cards, forms, catalogues and all current product literature.

Thus, the Altair Ambassador will receive full support from MITS so that he may best sell to and service his community, while making money at the same time. The only investment the Ambassador need make is travel and lodging expenses for the weekend training session in Albuquerque. Thus, if you own a MITS Altair System, and reside in a city without an Altair retail center, you may very well be the local computer expert whose future is to be an Altair Ambassador.

Please write for more information and an application form to:

Altair Ambassador Program
MITS, Inc.
2450 Alamo SE
Albuquerque, NM 87106

Program Progress

Due to the increased interest in developing programs for very specific needs, beginning next month we'll be offering "Program Progress" whenever possible. Designed to give readers an opportunity to suggest what programs they'd like to see in the Altair Software Library, the list of ideas will be published as long as you keep providing suggestions. We hope these suggestions for programs will be of particular interest to Altair owners.

So send your ideas to COMPUTER NOTES, and we'll pass them on to our readers.

BOOK REVIEW

Continued from Page Three

The second portion of the book brings the reader up-to-date with chapters on "The Present and Potential," "Applications" and "Governmental Uses" of computers. In "Justice, the Constitution and Privacy" Sam Ervin, Jr., U-S Senator from North Carolina, raises some interesting questions concerning the computer's role in government surveillance and the individual's right to privacy. On a more humorous side, Art Buchwald's "The Curse" warns of the horrible consequences a computer metes out when a defiant citizen dares to fold, bend and mutilate his phone bill and send it (with payment) back to the company.

The book's final three chapters --"The Impact of Computers," "Controls or Maybe Lack of Controls" and "Your Future"--explore the many significant effects the computer has upon our everyday lives and the potential role it plays in our country's future. Among the various articles in this section discussing both sides to the computer questionnaire, "Computerized Dating or Matchmaking," "Computer Crime" and "Machines Hold Powers for Good and Evil."

Interspersed among the many informative articles are imaginative poems, computer-generated illustrations and cartoons. Throughout the book, the famous comic strip character Doonesbury and his friend, Mark, marvel at the many wonders of the computer. A newspaper ad for computer operators convinces them that they have found their true vocation in life. "Earn $7,000, impress your friends. MEET GIRLS!"

In addition to all that humor, intrigue and important information to both the computer and noncomputer specialist, The Compleat Computer offers fictional romance about a computer named Max who almost breaks up a marriage. For $5.95 a copy, who could ask for more?

Copies of The Compleat Computer can be obtained directly from the publishers: Science of Research Associates, 1540 Pagemill Road, Palo Alto, California.

Van Tassel has also published Program Style, Design, Efficiency Debugging and Testing (Prentice Hall, Inc.).

LETTERS TO THE EDITOR

Continued from Page Two

Dear Ed.,

I am writing this letter for two reasons. Before I commence with the diatribe, however, I would like to say that I enjoy very much the 17K Altair 8800 system that is up and running at our house. We use the 8K version of BASIC.

On the very first page of the BASIC Reference Manual you state that BASIC was originally developed at Dartmouth University. This is incorrect. I am a student at Dartmouth College; to myself and all other Dartmouth students and alumni this reference to the "university" is a slur.

The distinction, seemingly minor, is historically and legally quite important. In 1818 the state of New Hampshire tried to take control of the College and turn it into a state school. They were partially successful, in that Dartmouth University was created. The University used the same classrooms, dormitories, and chapel as the College. Needless to say, there was considerable unrest from both students and faculty.

In 1819 the problem reached the Supreme Court. Daniel Webster (class of 1801) argued eloquently for the College and triumphed. The Dartmouth College case was a landmark decision that guaranteed the inviolability of legal contracts.

So you see when you attribute BASIC to Dartmouth University, you credit an unenduring and illegal "splinter school" of the early 1800's. Please try to correct this error in subsequent printings of the BASIC manual.

When working on the Dartmouth computer, I have found that the VAL and STR$ functions are useful. VAL takes a single string argument and converts it to a constant:

```
X$="-17.69"
X=VAL(X$)
```

X equals -17.69. STR$ does the opposite:

```
X=25*25
X$=STR$(X)
```

Therefore, X$="625". Also useful is the POS function, which searches a string for the presence of another string and returns the substring's location:

```
Q=POS(A$,B$,C)
```

POS looks for the location of B$ in A$ starting at location C in A$:

```
A$="ALTAIR"
POS(A$,"T",1)=3
POS(A$,"LTA",1)=2
POS(A$,"Z",1)=0
POS(A$,"LTA",3)=0
```

Thank you for your time.

Sincerely,
John Sotos

Ed. Note: STR$ and VAL are present in 8K and Extended BASIC, and the equivalent of the POS function in Extended BASIC Ver. 3.4 is INSCR.

CUSTOMER SERVICE NEWS

- continued from page 2

Shipping and handling charges - Rates for continental United States shipments - Prepaid or UPS COD:

$8.00 each for mainframes and terminals

$3.00 for up to three (3) peripheral boards, add $1.00 per board thereafter.

We are unable to ship COD to the following:

(1) Post Office Boxes
(2) Companies or Educational Institutions
(3) APO or FPO Addresses
(4) Foreign Countries (including Canada)

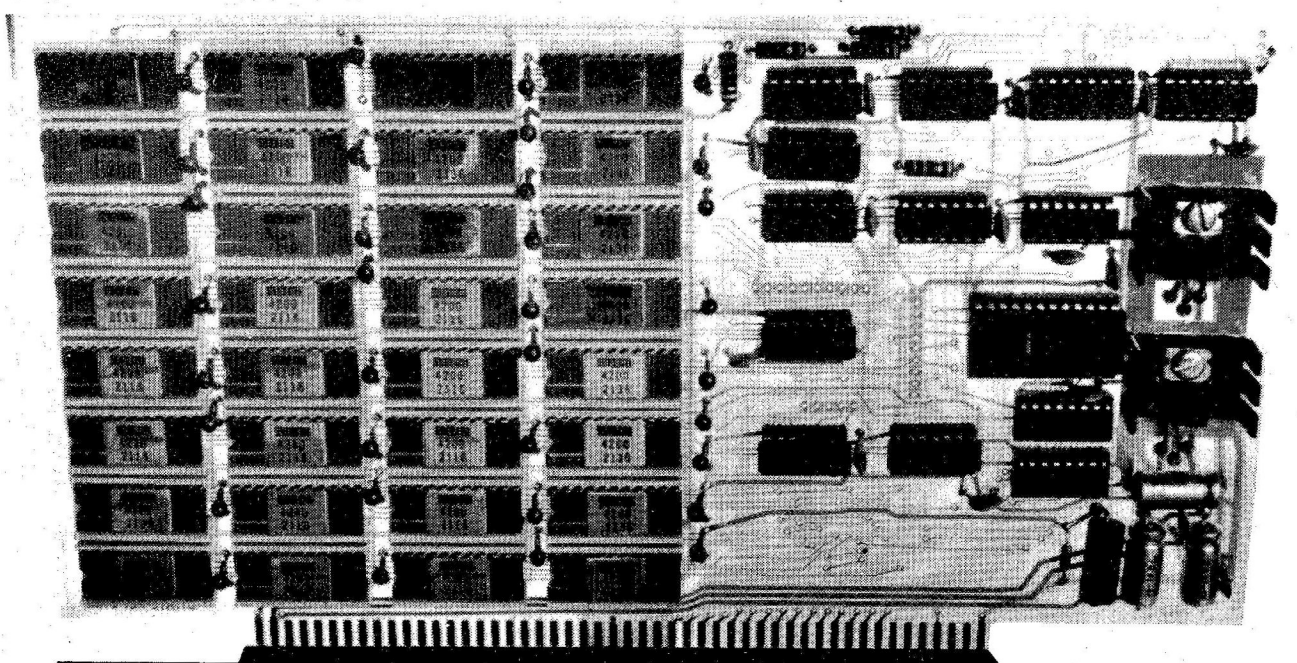
Foreign Countries (including Canada) - Repair shipments will be made via Emery Air Freight Collect. Also, charges incurred for units coming in from foreign countries to MITS, e.g. customs charges, will be billed as part of the customer's repair charge. (These charges average between $30.00 and $40.00.)

Please remember to send in payment for these charges, otherwise a delay will occur while we contact you for payment or COD authorization. We will accept for payment: Master Charge, BankAmericard, money order, personal check (three week delay for processing) or authorization for COD for charges under $15.00. Companies and educational institutions should remember to send in their Purchase Orders authorizing repair and return shipment charges.

I hope this will help those of you asking what our procedure is for returning items for repair. If you have further questions, please contact the Repair Department.

See you next month - Gale

One Slot!



Altair™ 16K Static

Almost too good to be true, the Altair 16K Static RAM board is easily the most advanced memory module yet developed for the Altair 8800, 8800a and 8800b computers.

Four Altair 16K Static boards add up to the entire 64K of memory directly accessible by the Altair.

The Altair 16K Static board offers two surprise features—minimal power requirements and fast access time. One Altair 16K Static board draws less current than any 8800 compatible 4K boards, thus four Altair 16K Static boards can be plugged into the Altair 8800 without beefing up the power supply.

The maximum access time of the Altair 16K Static board is 215 nanoseconds, which makes this board the **fastest Altair compatible static board in existence.**

The Altair 16K Static is now in full production. Special introductory price is $765 in kit form and $945 assembled.

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☐ Altair 16K Static ☐ Kit ☐ Assembled
(include $3 for postage and handling)

☐ Please send free information package and price sheet.

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Prices, delivery and specifications subject to change. Allow up to 60 days for delivery.

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